



## Project Introduction

Over the last decade, the application of hyperspectral data to estimate foliar traits in vegetation has exploded in use, including applications in agriculture and phenotyping, ecosystem functioning and biodiversity. There is an urgent need for a common set of software tools and open-source repository for those tools and spectral models derived from spectral data. Our effort focuses on developing the software, database/accessibility tools and web front- and back-ends needed to ensure open-source usage of spectral data among a large user community, including: data repositories, data processing tools, and spectral model distribution. Building on our previous EcoSIS.org effort, we will greatly expand the functionality of open-source tools for spectral data analysis, thus reducing barriers to entry for new researchers wanting to make use of field and/or imaging spectroscopy. This proposal is being submitted under the Data-Centric Technologies core topic area. Our primary target audiences are users wishing to scale from ground measurements to imagery or simply to use existing published algorithms to predict foliar traits from new ground reflectance or imaging spectroscopy data. EcoSIS.org is an easy-to-use online database that we developed with NASA support for storing, documenting, and distributing vegetation-themed spectroscopic datasets. The EcoSIS data portal makes contribution of rigorously-attributed datasets intuitive and uncomplicated. Ancillary data, such as chemical and physiological traits, as well as spectroscopy metadata, are easily added to make datasets discoverable across the internet, facilitate synergistic studies, and provide data to inform remote sensing research. Datasets published via EcoSIS are eligible to receive a DOI, providing persistent access by the user community as required by peer-reviewed journals and funding agencies. We propose to expand participation in EcoSIS by creating a suite of complementary open-source tools — the EcoSIS Toolkit — that make processing and preparation of spectral data straightforward, further removing the potential barriers to entry for those whose research would greatly benefit from the inclusion spectroscopy datasets and models. Throughout the development process for all tools we will employ Agile practices to iteratively add and test new features. All software developed through this project will use only open-source technologies and will be licensed under the Apache Licence 2.0 (<http://www.apache.org/licenses/LICENSE-2.0>). We will develop: 1) the Ecological Spectral Model Library — EcoSML.org — an online repository that distributes model parameters, example code, and other supporting resources related to spectra-derived models used to predict sample traits from spectra; 2) EcoSIS SDK library packages for popular scientific open-source languages to interface with EcoSIS; 3) the Spectroscopy Data Abstraction Library (SpecDAL, <https://specdal.github.io/>) will be an open-source Python library. Inspired by GDAL (<http://www.gdal.org/>), it will provide functions and classes to work with data files from industry-standard portable field spectrometers as well as custom built instruments; 4) HyTools, a toolbox of open-source Python programs used to perform necessary processing of hyperspectral images, providing a source to new users for code that has either been part of



Spectral data discovery, access and analysis through EcoSIS toolkits

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## Organizational Responsibility

### Responsible Mission Directorate:

Science Mission Directorate (SMD)

### Lead Organization:

University of Wisconsin-Madison

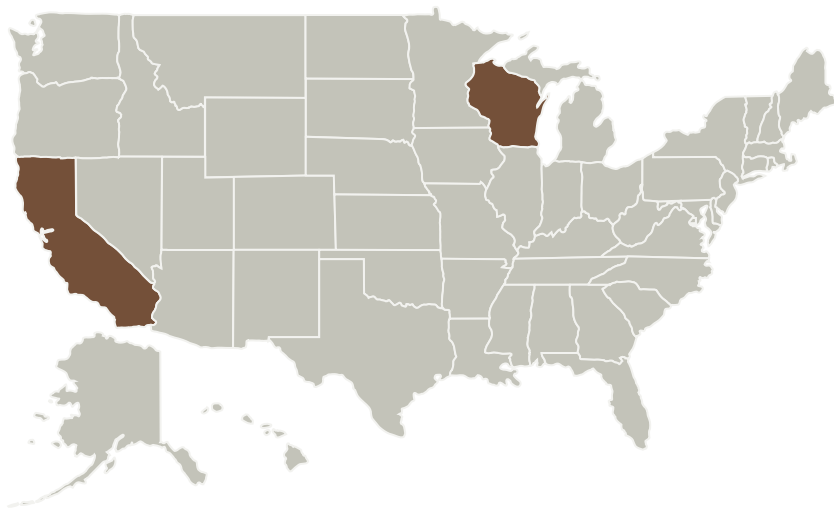
### Responsible Program:

Advanced Information Systems Technology



closed-source software packages or developed by individual researchers on an ad hoc basis. No comparable resources for these proposed functions are widely available, although there are some disparate sources on the web providing these functions. During this 2-year project, EcoSML will enter at TRL 2 and exit at TRL 4, while the SDK libraries, SpecDAL and HyTools will enter at TRL 3 and exit at TRL 5-7.

### Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
University of Wisconsin-Madison	Lead Organization	Academia	Madison, Wisconsin

Primary U.S. Work Locations	
California	Wisconsin

### Project Management

#### Program Director:

Pamela S Millar

#### Program Manager:

Jacqueline J Le Moigne

#### Principal Investigator:

Philip A Townsend

#### Co-Investigators:

Sarah M Marcotte

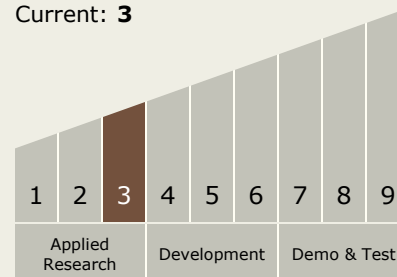
Clayton Kingdon

Justin R Merz

### Technology Maturity (TRL)

Start: 3

Current: 3



### Technology Areas

#### Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.1 Software Development, Engineering, and Integrity

*Continued on following page.*



## Technology Areas (cont.)

- └ TX11.1.7 Frameworks, Languages, Tools, and Standards

## Target Destination Earth